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Building a Future-Ready Community of Interest

Cognitive and Social Issues

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Abstract

The NAVSTAR Global Positioning System (GPS) provides space-based position, navigation, and time (PNT) to millions of worldwide users. GPS consists of a space segment, user segment and control segment supplemented by a network of monitoring stations and external interfaces, connected by a point-to-point communications network. This network is transitioning to a net-centric information sharing and security environment that will replace the point-to-point network by a service-oriented architecture, connected by a global network known as the Global Information Grid. This is a complex endeavor that requires inter-agency cooperation, communication, and collaboration to ensure integration across the Department of Defense (DoD).

The transition to net-centricity has been approached in a very agile fashion. The DoD has introduced the idea of organizing assets and personnel around mission areas in Communities of Interest (COIs) to facilitate this transformation. The DoD has recognized that stringent standards, inflexible rules, and checklists are barriers to innovation and interoperability, so guidance has been kept general and high-level. However, this has resulted in a variety of approaches to COIs and net-centric service development, accompanied by a set of evolving guidance. This situation has caused a level of apprehension to adopting COIs and net-centric development by the acquisitions programs. This paper addresses this issue from the point of view of the authors who were involved in both the program acquisition and net-centric transformation activities. It provides lessons learned from the formation of the GPS COI and their initial net-centric service development activities. The lessons learned provide an example of what issues were faced, how these issues were handled, and what the outcomes of those actions were. These lessons learned are intended to help programs anticipate and respond to future issues and evolving guidance that may arise during net-centric service development.

Keywords: GPS, DoD, COI, net-centricity, SOA, SCA

INTRODUCTION

The NAVSTAR Global Positioning System (GPS) provides space-based position, navigation, and time (PNT) to millions of worldwide users. GPS consists of a space segment, user segment and control segment supplemented by a network of monitoring stations and external interfaces, connected by a point-to-point communications network. This network is transitioning to a globally connected grid as part of the DoD transformation to a net-centric environment. Part of the DoD transformation is a new communications infrastructure that connects the warfighter to multiple information systems by a global network known as the Global Information Grid (GIG). The transition is very complex, as many agencies and programs need to coordinate their efforts to transform to a net-centric environment. The Community of Interest is the DoD method of organizing personnel and assets to facilitate this transformation.

This paper is presented as a set of lessons learned during the formation and initial service development efforts of the GPS Community of Interest. The authors were involved in activities in both the GPS Wing Acquisitions Program Office (GPSW) and the GPS COI. The lessons learned are taken from issues that the GPS COI encountered when performing net-centric activities, such as service planning, in conjunction with the GPSW. The way in which the GPS COI approached these problems and developed solutions is in accordance with the lessons learned from previous COIs, and also takes the DoD enterprise guidance into account. It is the authors' hope that these lessons will prove useful to future COI-building efforts of other programs, and that the DoD may find a way to address these issues in future guidance and policy documentation. The end goal is to ensure that COIs will anticipate and respond to future issues, ensuring the ability to deliver capability to the warfighter well into the future.

NET-CENTRICITY BACKGROUND

The Department of Defense (DoD) is transforming the way it conducts warfare, business operations, and enterprise management. As part of this transformation, the DoD has embraced the concept of "net-centricity", which is the realization of a robust, globally interconnected, network environment in which data is shared in a timely and seamless way among users, applications, and platforms during all phases of warfighting efforts [DoD CIO, 2007 (2)]. Net-centricity facilitates an information superiority-enabled concept of operations that generates increased combat power by networking sensors, decisions makers, and war-fighters to achieve shared situational awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability and a degree of self synchronization. The DoD approach to achieve net-centricity has been driven by three main factors: a global information grid (GIG), service-oriented architecture (SOA), and the semantic web.

The GIG is the realization of the robust, globally interconnected, network environment. The GIG consists of the IT assets, people, and processes that participate in and govern information sharing for the DoD enterprise [DoD CIO, 2007 (2)]. The GIG standardizes the interfaces of the connected systems to a set of technical standards. These standards are enforced by interoperability testing and certification prior to connection to the GIG, and provide a common infrastructure for inter-system operation. The GIG utilizes a service-oriented architecture, which aligns DoD enterprise business processes with the mission needs of the warfighter.

A service-oriented architecture is a paradigm for organizing IT assets that may be under different ownership domains and exposing their capability as a Service. In an SOA, a set of loosely coupled services works together seamlessly and securely over a network to provide functionality to end users [Erl, 2005]. In the DoD enterprise, service providers publish their data and services to the GIG and register information about their Service interface with a service broker or registry. Service consumers query the service registry to discover services that meet their needed capability, and invoke the service through the service interface. Loose coupling enables service composition into higher-level business functions, transparent to the service consumer [DoD CIO, 2007]. These SOA attributes

result in reuse and redundancy, which increases the efficiency and survivability of the enterprise. However, the service broker and service consumer require semantic information about a service to ensure that the consumer's capability needs can be met by the service. Additionally, service composition requires interoperability within the system and with external partners. The DoD has chosen to tag services and data with metadata to ensure that the service being accessed is understandable, trustable, and interoperable, using semantic web technology.

The Semantic Web is not a separate Web but an extension of the current one, in which information is given well-defined meaning, better enabling computers and people to work in cooperation [Berners-Lee, 2001]. The Semantic Web will allow machines to comprehend documents and data that are tagged with semantic metadata, and governed by ontologies. Through these technologies, the vision of an automated, interconnected network of machines talking to other machines can be realized.

FUTURE-PROOF THE COI

The DoD initiated an effort to capitalize on the benefits of mass collaboration and alignment of program acquisitions with warfighter needs by establishing the concept of the Community of Interest (COI) [Bradley, 2007]. A COI consists of information owners, producers, consumers, and stakeholders who must collaborate to solve an information sharing problem. COI activities include the creation of shared semantics, vocabulary, metadata, and the development of net-centric services to solve the common information sharing problem. Institutional COIs are one type of COI that interfaces programs of record who create information systems and manage the associated data, with the operators and warfighters that must use the information systems. These COIs are primarily concerned with determining the data that the warfighter needs from their associated information systems, and making this data accessible via the GIG.

Ideally, institutional COIs should begin with a COI that is centered around a single program, and grow to encompass several programs of record that produce or consume data in the same mission area. By starting with a single program of record, the information sharing problem is scoped to a single program that has the control and the budget to solve the problem in an expedient manner. As related programs undergo net-centric transformation, they can provide assistance to the mission-area COI as schedule and resources permit. As the COI grows to encompass these related programs, the semantics are shared and extended, which facilitates interoperability within that mission area. The interoperability and shared understanding create a cohesive set of net-centric services to provide that warfighter capability.

The result of this incremental COI growth is that each mission-area COI will have data, organization, and policies that are tailored to best provide their capability to the warfighter. Enterprise interoperability can then be handled at the COI level, by identifying areas of overlap and resolving interoperability issues in these areas between COIs. The Air Force has approached the enterprise interoperability issue by creating an enterprise vocabulary team that works across COIs to develop enterprise interoperable

semantic vocabularies specific to each COI. This activity limits semantic interoperability concerns to areas of overlap between COIs. However, many institutional COIs are initially misaligned with a mission area, and the COI leadership and governance structure may be dominated by the early membership rather than equal proportions of the major mission area programs.

The problem with incremental growth is that a COI based on a single program of record may make decisions that are in the best interest of the program, rather than the enterprise. Likewise, if the full warfighter community for a mission area is not engaged, decisions may be made that are in the best interest of the current COI membership, rather than the enterprise. Steps must be taken to ensure that the enterprise goals and concerns are given priority when building a COI that will persist into the future. One step is to first identify the mission area and warfighter capabilities that the program contributes to, and to identify other programs and COIs that also contribute to those areas. A second step is to develop a COI leadership and governance structure reflective of the enterprise mission area, rather than a structure based on active membership.

In order to prevent program-scoped services and provide a larger mission area context, COIs should create a set of mission threads as part of their business process modeling activities. Business processes should be captured as warfighter capabilities or effects that are independent of implementation. These business processes can be derived from the system's concept of operations to ensure traceability to a set of capabilities that the system is funded to provide. These capabilities can then be composed from a series of activities that have to be completed in order to achieve each mission or capability. These "mission threads" can then be decomposed into the net-centric service offerings of the information systems in various COIs. Any related COIs should be involved in the coordination of development activities, as decisions made in one COI could affect the mission threads, service planning, and design activities of overlapping COIs.

NON-TECHNICAL SOLUTIONS

Sometimes a technical problem, such as net-centric service development, requires a non-technical solution, such as socialization. Both the program office, responsible for system acquisition, and the COI, responsible for enterprise interoperability, needs to understand and agree on the scope and direction of the net-centric service development activity. This understanding can be reached via a series of socialization briefings that describe the mission, function, and benefits of the COI. After the program forms or joins a COI, they should support their COI by redirecting manpower from their related functions and internal working groups to work on COI activities. In addition, programs should lend subject matter experts from their operational units to support the development of vocabulary and metadata.

Socialization needs to occur at both the leadership and program working group levels in order to align budget and activities in support of COI activities. This activity can be difficult if the organization membership has an incomplete or incorrect understanding of net-centric concepts, or if they are simply unwilling to change. Socialization should

result in the alignment of program goals with enterprise goals. After socialization, program leadership should understand that all the system data belongs to the DoD enterprise, and is therefore inherently shareable as an enterprise asset. No data or interface should be excluded from possible sharing, and new interfaces should not be created as a "stovepipe" legacy point-to-point connection. Information assurance efforts by the program need to be adjusted accordingly for this mindset. A program's information assurance efforts often prohibit information sharing, when they should instead facilitate trusted information sharing across the enterprise. This shift in mindset can be summarized in the following quote from Vice Admiral Nancy Brown, US Navy, "We must stop building walls and digging moats as our primary means of protecting the network."

In addition to a lack of socialization among programs, COIs suffer from a lack of tools to support collaboration. COIs need collaboration tools to support their efforts, as COIs are built from geographically dispersed individuals from different organizations. This obviates the need for some way to query and find individuals across the enterprise, like a facebook [Pearlman, 2008] application for the DoD. Unfortunately, this service, and other enterprise tools such as chat, messaging, and file sharing are not currently standardized or accessible. Collaboration is currently performed in an ad-hoc manner, distributed across a variety of enterprise, service component, and contractor-provided proprietary tools. These tools all need to support data separation, multi-level security, and user authentication to ensure that they safeguard DoD program information and contractor proprietary data. The natural choice for these tools is the net-centric enterprise services (NCES) [DISA, 2007]. NCES tools are projected to provide services such as chat, web conferencing, file sharing, and people discovery. However, most NCES tools are not yet available, and NCES use is dependent upon the creation of a Defense Knowledge Online (DKO) account, which needs to be streamlined for broader and easier adoption if NCES tools are to be used mainstream. COIs will have a difficult time overcoming the geographic and organizational boundaries without these enterprise collaboration tools. Probably the best solution is for NCES to provide a comprehensive tool set that is available to all COIs as they form. This would provide a common foundation for the development of COI products across the enterprise.

AGILE SERVICE DEVELOPMENT

Net-centric services must be developed in accordance with enterprise guidance and within collaborative efforts of the COI. However, development efforts also need to take program-specific schedule and cost factors into account. Agile software development methods can support net-centric service development by correlating the program office and COI goals and activities. Agile software development methods can benefit net-centric service development, including: the use of an incremental, spiral development model; early prototyping; and tightly-coupled development with warfighter feedback.

The incremental, spiral development model consists of several steps that are similar to the iterative development model of the rational unified process (RUP) [Jacobsen et al, 1999]. In addition, the mission thread analysis described previously can add value to the service

development effort. First, the identification of shared data can be performed as an extension to mission thread analysis. This activity will identify legacy data shares as well as any data needs from associated COIs. One lesson learned is that the data elements identified should initially be kept at a conceptual level, which will aid COI vocabulary development activities. Mission threads analysis can also identify service dependencies. Services can be decomposed into increments that can be composed to successively build additional capability for the warfighter. Composite service development is in accordance with the building-block methodology described in the DoD Chief Information Office (CIO) net-centric services strategy [United States, 2007]. This method has been successfully employed by several projects, including DISA's NCES development team, and the Maritime Domain Awareness (MDA) COI. Composite services will have to rely on a common infrastructure in each increment. There are a few common service infrastructure models available, such as the Open SOA service component architecture (SCA) [OSOA, 2007]. A common service infrastructure provides a standard for convergence, which is beneficial for enterprise interoperability.

Each net-centric service increment should result in a prototype that is tested by the warfighter. This will help the program adapt to a dynamic environment in which the warfighter may experience changing needs and requirements. The rapid prototyping delivers a forum for the warfighter to provide valuable feedback to the developer. Past projects, such as the Maritime Domain Awareness Pilot Program [Todd, 2007] have attributed the closely-coupled warfighter/developer feedback as a significant factor to the overall success of the program. The success of these service prototypes should be based on the warfighter feedback on the service utility as well as the expediency and efficiency of data sharing.

A COI based on a program of record may initially focus on publishing system data to the GIG, and leave the warfighter to develop applications that are tailored for their needs. This approach can be summarized as "build it and they will come." However, this does not imply that the COI will never develop services that deliver capability to the warfighter. Services that deliver usable capability to the warfighter should be incrementally built by the COI, in conjunction with the warfighter, after the relevant data has been exposed. The funding for those services should come from the program if it is a capability that the program is supposed to provide. Otherwise funding should come from the warfighter that desires that capability, or send through the joint capabilities integration and development system process to add the funding and capability to the program that provides the data.

CONCLUSION

Although net-centric philosophy implies the creation of COIs centered around mission areas, the authors advocate the opposite; creation of a COI built around a program of record. Practice has found that institutional COIs can grow into a larger mission-area COI as long as the COI governance is built in context of the mission area into which the COI will grow. These smaller COIs will require less complex socialization, coordination, and budgeting for service development, due to their decreased size and scope. This can

result in savings of time and cost, and less overall program risk due to less dependence on external organizations. Related programs will benefit from reuse of the existing COI vocabulary and metadata products.

Despite the method in which a COI is formed, all COIs will need better enterprise support to be successful in the future. COIs need more socialization in the DoD enterprise, especially among senior leadership. Senior leaders need to understand the benefit of COIs to align the activities of the programs under their command with the net-centric way of thinking. In addition, COIs need freely available collaboration tools that are common across the enterprise to support their efforts. NCES is an option, but the accessibility of the NCES tools is a hindrance to their adoption.

Service development is often seen as a balance of providing what is best for the warfighter with what is best for the program's schedule and budget. Both needs can be met by using the principles of agile development, which have not only proven to reduce risk by developing in increments, but also provide value to the warfighter by early prototyping and incorporating feedback in future spirals, or iterations.

There are many challenges to implementing an information sharing, mass collaboration, net-centric environment for the DoD enterprise. One of the most formidable challenges is the development of a stable foundation for a COI amidst the rapid pace of technological change. It is the authors' hope that the lessons learned from the formation and initial activities of the GPS COI will help the DoD enterprise form COIs and develop information sharing solutions that will be ready for any future challenges and stand the test of time.

DISCLAIMER

The views expressed in this paper are representative of the authors and are not necessarily the viewpoint of MITRE, the United States Air Force, or any other related organization.

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